OSPF

- area
  - backbone area 0
    - all areas need to be connected
  - ASBR
    - autonomus system border router
    - redistributes routes from other networks
  - ABR
    - Area Border Router
    - Connects areas to Area 0
  - max 1 area per Interface
    - configuration
      - (router) network #ip area #id — includes only matched secondary networks
      - (int) ip ospf #id area # — includes all secondarys on int
  - ID
    - 32bit field
    - decimal or dotted-decimal
  - Stubby Areas
    - ABRs advertise default route — metric = 1 — (router) area # default-cost #
    - must be configured on each router
    - stubby
      - type 5/4 LSA filtered
      - (router) area # stub
    - totaly stubby
      - Type 3-5 LSA filtered
      - (router) area # stub no-summary — only on ABRs
    - nssa
      - not so stubby area
      - can redistribute from ASBRs — using Type 7
      - no default-route
      - (router) area # nssa
      - [default-information-originate]
    - totaly nssa — (router) area # nssa no-summary
    - verify — sh ip ospf
- Links
  - S. 163
  - Frame Relay
    - problem — mutipoint interfaces
      - partial mesh — ev no connection to all routers in a subnet
      - no discovery
    - with DR — DR needs a PVC to every router
    - with DIscovery — need broadcast parameter
      - (int) frame-relay map ip #ip #dlci broadcast
  - types
    - broadcast
      - DR
      - Discovery
    - non broadcast
      - DR
      - no Discovery
      - need static neighbors — (router) neighbor #ip
    - point-to-point
      - no DR
      - Discovery
      - use on Back2Back ethernet Links
    - point-to-multipoint non broadcast
      - no DR
      - no Discovery
  - config — (int) ip ospf network #type
  - verify — sh ip ospf interface #int
- Neighbors
  - states
    - Down — no hello received
    - attempt
      - static neighbor
      - hello sent
    - Init
      - hello received
      - if permanent -> parameter missmatch
    - 2Way — all neighbor verification passed
    - ExStart — startign DD exchange
    - Exchange — exchanging DDs
    - Loading — Requesting LSAs
    - Full — LSDB complete
  - exchange
    - without DR
      - highest RID = master
        - master initiates echange
        - only master can increment SN
      - Multicast DDs — 224.0.0.5
    - with DR — all Routers exchange DDs with DR — 224.0.0.6
  - DR
    - election
      - highest Priority — (int) ip ospf priority # — 0 = never
      - highest RID
    - on DR Fail
      - BDR -> DR
      - new BDR elected
      - no change until DR fail
  - authentication
    - config
      - (router) area # authentication message-digest
      - (int)ip ospf authentication message-digest
      - (int) ip ospf message-digest-key #nr md5 #value
    - send and receive with all keys
  - virtual links
    - to connect an ABR to Area 0 using a transit area
    - Do Not Age — no periodic reflooding
    - messages sent as unicast
    - config — (router) area # virtual link # RID
      - # of transit area — non stubby area
      - RID of other ABR-Router of transit area — may not be pingable
      - authentication message-digest
      - massage-digest-key # md5 #value
    - verify — sh ip ospf virtual-links
  - requires
    - subnet must match
    - MTU must match — ip ospf mtu-ignore
    - timers must match
- Route filtering
  - Type 3 LSAs
    - on ABRs only
    - (router) area # filter-list prefix #name in | out
  - routing table
    - on each router
    - (router) distribute-list #parmeter in [interface #int]
      - int = outgoing int
    - Filtered Type 3 routes are not advertised
- gracefull restart
  - Non Stop Forwarding(NSF)
  - restart of the routing process
  - router notifies all neighbors — all neigbors need to support it
  - need to be in grace period
  - conf — (ospf) nsf [cisco | ietf] helper disable
- default route
  - summary to 0.0.0.0/8
  - (router) default-information originate [always] [metrix #] [metrix-type #] [route-map #]
    - default metric = 1
    - metric-type= external 1/2
    - advertise type 5 LSA fpr 0.0.0.0/0
    - only if default-route exists
      - use allways
      - use route-map to decide
  - wait for bgp
    - max- metric router-lsa on-startup #s
    - max-metric router-lsa on-startup
    - wait-for-bgp
  - redistributing not possible
- LSDB
  - Router ID
    - need to be uniq
    - (router) router-id
    - may not be reachable
    - IOS
      - highest loopback IP
      - highest interface IP
    - IOS XR
      - lowest loopback IP
      - lowest Interface IP
  - Messages
    - Hello
      - multicast 224.0.0.5 — IP protocol 89
      - timers
        - default
          - LAN 10:40
          - P2MP 30:120
          - NBMA 30:120
        - (int) ip ospf hello-intervall #s — dead-intervall = 4x#
        - (int) ip ospf dead-intervall minimal — dead-intervall= 1
        - hello-multiplier # — hello intervall = 1/# — not supported on IOS-XR, use BFD
        - (int) ip ospf ded-intervall #s
      - data
        - Router IP*
        - Sub area flag*
        - hello intervall*
        - dead intervall*
        - subnet mask — must match
        - list of Neighbors
        - Area ID*
        - Router priority
        - DR IP
        - BDR IP
        - Auth Digest*
    - DD/DBD — Database Discovery
    - LSR — LSA Request
    - LSU — LSA Updates
    - LSAck
  - LSA
    - Link State Advertisement
    - Type
      - 1 Router
        - sent by each router
        - only intra-area
        - include direct connected networks
      - 2 Network
        - sent by DR
        - transit Networks
        - ID = DR RID
      - 3 Summary — sent by ABRs to other areas
      - 4 ASBR Summary
        - sent by ABR
        - when receiving Type 5/7 LSA
        - Address+Cost to ASBR
      - 5 AS External
      - 7 NSSA External — is translated to Type 5 on ABR
    - timers
      - default 30min — per LSA Refresh
      - default 60 min — per LSA Maxage timer
  - SPF
    - analyze LSDB — find all posible routes
    - Calculation
      - calculate costs
        - all outgoing interfaces
        - inter-area routes
          - cost= cost to ABR + reported cost
          - ABRs ignore T3 LSAs
            - on none backbone Areas
            - for own routes
        - config
          - ref bandwith
            - (router) auto-cost reference-bandwith #mbps
            - default 100
            - ref BW / int BW = cost — min = 1
          - (int) ip ospf cost #
        - verify
          - sh ip ospf interface brief
      - rules
        - intra-area route over interarea route — E1 over E2
        - infinit metric 16,777,215 (224 – 1) — for down routes
      - equal cost multi-path
        - IOS max 4
        - IOS-XR max 16
        - maximum-paths #nr
- summary
  - only on ABR/ASBR into Area 0
  - only advertised if one subnet exists
  - best cost used for summary
  - config
    - ABR
      - (router) area # range #IP #mask [cost #] — do not advertise summary or sub routes — [not-advertise]
      - area # of source Area
    - ASBR — (router) summary-address #IP #mask
  - prefix suppression
    - suppress all but loopback addresses — for SP core networks
    - suppress stub-networks
    - not supported on XR
    - (router) prefix-suppression
    - (int) ip ospf prefix-suppression